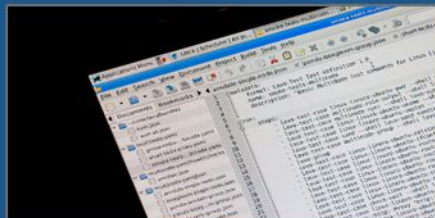
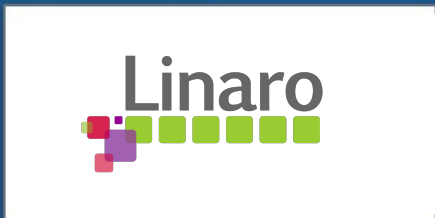


From 96Boards to the Cloud

Presented By: David Mandala, Director of Systems, Linaro

Event: Embedded Linux Conference 3 April 2016

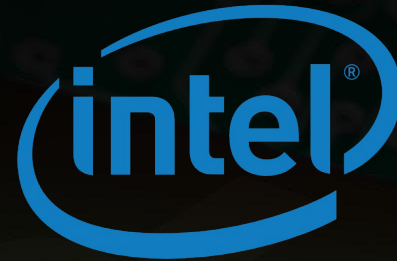


Who is Linaro

Who is Linaro?

- ▣ Linaro is a collaborative engineering organization
- ▣ Our Mission:
Leading Collaboration in the ARM Ecosystem

Why do we need Linaro?

The ARM logo is displayed in a bold, blue, sans-serif font.

ARM's business model leads to an unprecedented level of innovation in SoCs

Intel's quarterly R&D budget is over 2x ARM's annual revenue **Linaro is where the ARM partnership works together to invest in the ecosystem**



What does Linaro do?

- ▣ Focus on Open source software
- ▣ Linaro members fund 220 OSS engineers to develop software collaboratively
- ▣ Software is built once and shared by all
- ▣ Work is open, tested and upstreamed



Linaro Core & Club Members



Plus 20 Group Members



Celebrating 5 years of Open Source Engineering on ARM

Linaro

24TB



data from June 2014 - May 2015
615,000 downloads from >100 countries



16 Connects

14 Cities on 3 continents



32 member companies

Six members at launch



4,410

gallons consumed at Linaro Connects

1,141,014

minutes of videos showing demos, talks and training sessions watched

More than 
220 Engineers
from seed of twenty

#3



11,589

patches upstream since 2011 



~20
hardware platforms

company contributor for
Linux Kernels 3.11 - 3.18

www.linaro.org
www.96boards.org

"The ARM situation has just improved tremendously over the last several years. It used to be a major pain to me, it has gone to almost being entirely painless."



- Linus Torvalds
May 2015



50,217
Wiki pages



>1 Million
website users



CORE
Level



Linaro Members

CLUB
Level

MEDIATEK

everyday genius



socionext™
for better quality of experience



life.augmented



Tomorrow never waits



GROUP
Level



ATAP Advanced Technology and Projects



Acadine Technologies



COMMUNITY
Level



Linaro: End-to-end ARM-based Solutions



LITE

IoT client
Smart sensors
Embedded devices



LMG

Phone
Tablet
Wearable



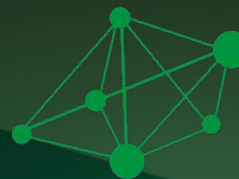
LHG

Home
entertainment
Sensor hub
Gateways



LNG

Networking
Data plane
(ODP)



LEG

SDI
Developer Cloud
Big Data
HPDA

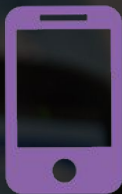


LITE IoT and Embedded



- Proposed new Linaro Segment Group
- Interim SC and projects underway
 - Reference IoT software across Cortex A and R/M
 - RTOS, GPIO, I2C, SPI, BLE, 6LoWPAN, CoAP, DTLS, Thread, MQTT
 - ...
 - Sensor/Smart Device/Gateway
 - Open Source Software from the sensor to the cloud

LMG Mobile



- Continued focus
- Volume, competition, drives innovation
 - Google Android, Acadine H5OS
 - Performance, power management, footprint
 - Project Ara
- Features migrate to IoT and Enterprise

LHG Digital Home



- Open Source Platforms
 - Android
 - Comcast RDK
 - China TVOS
- Focus on security and media frameworks

LNG Networking



- ODP - APIs for dataplane SoC acceleration
 - "Monarch" release Q2
 - "Tiger Moth" release Q4
- ToR switch, Smart NICs, Edge devices/NFV
 - Leverage ODP for HW acceleration

LEG Enterprise



- Platform for the data center
 - ARM SoCs for the data center & cloud computing
- Firmware
- SDI (OpenStack), OPNFV, Big Data (Hadoop, Spark/MapR), HPC

What do we need to accomplish our mission?

- Software Engineers to develop and debug software
 - ◆ We have quite a few of those. ;-)
- Hardware to develop and debug software on
 - ◆ This is slightly harder
 - ◆ In many cases it's easier for software developers to work on local hardware; to give all of our software folks a local system it needs to be inexpensive (to some meaning of the word)

96Boards



96Boards

- ▣ Linaro designed the 96Board specification
 - ◆ Currently 2, with more in development
 - CE Consumer Edition (CE)
 - Enterprise Edition (EE)
 - Internet of Things (IE) [future specification]

More about this later...



Why 96Boards?

- A low-cost ARMv7 and ARMv8 open platform specification
- Software maintained by Linaro and community
- A single developer community, sharing solutions
- Open to all developers
- Hardware modules are portable across all 96Boards: choice leads to lower cost, faster innovation and larger market
- The goal is for 96Boards to be fully supported upstream



Why does 96Boards matter?

- ▣ An SoC independant open platform for a single ecosystem
- ▣ Active engagement and contribution from communities
- ▣ Reference Software Platform
 - ◆ It's not just about Hardware - **it never was!**
 - ◆ Unified Kernel and boot firmware roadmap promoting upstream
 - ◆ Default mechanism for Linaro Collaborative Engineering work
- ▣ Targeted platform for segment specific requirements
- ▣ Low speed Mezzanines are compatible across all 96Boards, pushing the boundaries of product design and application development
- ▣ If you use any one of 3 libraries to access GPIO, I2C or SPI you will have binary compatibility across boards
 - ◆ 96BoardsGPIO
 - ◆ Libsoc
 - ◆ Mraa & upm

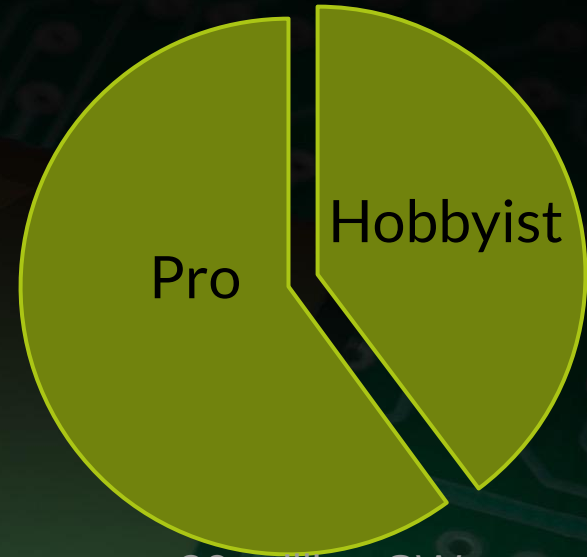


Target Markets for 96Boards



Software >60%
of cost of SoC
development**

- ▣ Commercial & higher education software development
- ▣ OEM/ODMs - for IoT, mobile, compute, enterprise
- ▣ Maker market - Robotics, UAV, HPC, etc



20 million SW
developers globally*

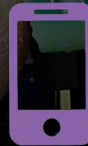
Sources: *IDC 2013,
**ITRS 2007, **IBS 2009

Cross vendor community hardware



- Key enabler for reference software platform
- Mezzanine ecosystem for peripherals & sensors

Linaro
Groups



96Boards
Editions

IoT Edition
Cortex-A & R/M

Consumer Edition
Cortex-A

Enterprise Edition
Cortex-A



Two Open 96Boards Specifications*



- Low cost ~\$50-150
- Mobile/Embedded SoCs
- For software developers, maker community, research, universities & OEMs



- Low cost ~\$300
- Server/Networking SoCs
- For software developers, universities & research, SoC evaluation and test/build farms

* Currently



96Boards Consumer Edition Goals

- ▣ An SoC independent low cost platform
 - ◆ Develop a larger hardware ecosystem & enable longer platform life
 - ◆ Reduce costs of embedded product development
 - ◆ Enable vendor differentiation
- ▣ Enable low cost (\$50-150 MSRP) community boards
- ▣ Delivery of a small form factor physical design
 - ◆ Standardized footprint
 - ◆ User connectors/access on front edge only
 - ◆ Small form factor (85 x 54 x 12mm total) with very low profile (7mm board to board separation), suitable for embedded product use

Consumer Edition Use Cases

- ▣ Out of the box Single Board Computer for software developers
- ▣ Expansion and customization options for the maker community
- ▣ Low-cost Single Board Computer for embedded OEM products

DragonBoard 410c



Supported OSes



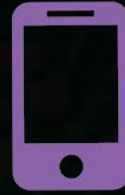
Supported IoT Platforms



IBM Bluemix™



Google AOSP



Support for HiKey 64 bit Octa Cortex-A53 96Boards
is now available in AOSP public tree

<http://source.android.com/>

A community board with ongoing support in
AOSP will help developers and peripheral
vendors to accelerate adoption in new
Android versions



96Boards Enterprise Edition

Coming in Q2 2016

LeMaker Cello

96Boards EE

Quad Cortex-A57

Gbit Ethernet

SATA/eSATA

x16 PCIe G3

SO-DIMMs up to 16GB



Enterprise Edition

- For Server/Networking Enterprise SoCs
- Low cost standalone format or microATX format
- 2-16GB DRAM or more with SO-DIMMs
- 1Gbit Ethernet port
- 2 USB 3.0 ports
- PCIe and display options
- Optional multiple SATA and networking ports
- Standardized 96Boards Maker IO interface
- 12V DC @ 5A -15A off the shelf power supply (or ATX)

Mezzanine Boards and Modules

- ▣ Build once and run on any 96Boards Compliant hardware
- ▣ Developer support infrastructure
- ▣ Enables a developer community around peripheral devices for SoCs (Communications, Sensors, Displays & Cameras)
- ▣ Join 96Boards Partner Program



Linker mezzanine card starter kit

Available now. 96Boards starter kit with Linker mezzanine card and loft modules



96Boards UART Serial Adapter

Available now: a USB to UART interface to be used with any 96Boards Consumer or Enterprise Edition board.



Mezzanine Products

Coming soon: I/O Expansion board for IoT/Sensor applications, with SoC and Arduino-compatible Grove module interfaces, and Arduino-compatible shield connectors.

OS Distributions

- ▣ 96Boards is distribution agnostic and welcomes community participation from all distributions and operating systems
- ▣ 96Boards products initially provide support for at least one of:
 - ◆ Debian, Ubuntu, Fedora, Android (AOSP), RedHat (EA) or an OE/Yocto Linux build
- ▣ Supported distributions will be available from 96Boards.org as pre-built images and build from source instructions

Community Web Site

- ◆ Open to all
- ◆ Specifications
- ◆ Where to buy
- ◆ Documentation
- ◆ Developer forum
- ◆ Software downloads

Reference Software Platform

Developer Cloud

The screenshot shows the 96Boards.org website. At the top is a navigation bar with the logo and links for 'About', 'Products', 'Projects', 'Blog', and 'Forums'. The main heading is 'Open Platform Specifications and Reference Software for the ARM ecosystem', with subtext 'For software developers • For the maker community • For embedded OEMs'. Below this are three main sections: 'Boards & More' featuring images of 'HiKey' and 'DragonBoard™ 410c' boards; 'Software' featuring a 'Reference Software Platform' logo made of puzzle pieces; and 'Developer Cloud' featuring a cloud icon with server racks. A white content area at the bottom is divided into three columns: 'Download Specifications' with links for 'CE Specification' and 'EE Specification'; 'On the Forum' with a list of topics including WiFi connection, Windows 10 Dragonboard 410c support, and Windows 10; and 'On the Blog' with a list of articles including 'Reference Software Platform 15.12 Release!', '96Boards 3D printable EE case', 'Pin X is Y or libsoc patches', and 'Servo Motor Control: generating a...'. The footer contains the Linaro and 96Boards logos.

Reference Platform

- End to end reference open source software
 - To provide cross-SoC reference implementation
 - Firmware to application use cases
- Why?
 - A reference “how to” implementation
 - Over time will benefit from multi-vendor and community participation
 - Saves duplicated engineering effort

Reference Platform

- Tested on 96Boards & member hardware*
 - Releases for Mobile/Embedded & Enterprise
 - Include latest Linux distributions - Android, Debian, CentOS
 - IoT, Digital Home and Networking versions coming soon
 - Designed to be easily ported for new SoC enablement
- Quarterly release cadence

[https://github.com/96boards/documentation/wiki/Reference-Platform-](https://github.com/96boards/documentation/wiki/Reference-Platform-Home)

[Home](#)

*Selected member-requested hardware by arrangement



16.03 RPB Kernel

- Unified kernel tree for CE and EE Builds
 - Supports HiKey, DragonBoard 410c, Huawei D02, APM X-Gene, HP Proliant m400 and AMD Overdrive
- Linux 4.4.0 based
 - Including under-review topic branches to extend hardware support for the available platforms
 - Device-Tree support for CE
 - UEFI, ACPI and PCIe support for Enterprise
 - Single kernel config for all platforms in arch/arm64/configs/distro.config

Linaro ARMv8 Server Cluster for Developers

▣ Want access to an ARM Server to test your software?

◆ Linaro can help you with that:

The Linaro ARMv8 server cluster is a virtual resource available to ISVs and other software developers who need access to enterprise-class 64-bit ARMv8 hardware before they can get hardware in-house. This server cluster will allow porting and verification of enterprise software on ARM 64-bit servers running standard Linux distributions.

- <http://www.linaro.org/leg/servercluster/>

Linaro Developer Cloud



- Linaro Cloud for Developers

- Why?

- A reference “how to” OSS implementation
- To provide public and restricted access to ARM servers
- For developers, ISVs and end users to evaluate/utilize member hardware with forums and developer support
- For Cloud providers who want a known starting point to provide ARM server infrastructure

Linaro Developer Cloud



- Run on Linaro and Member/Partner facilities
 - Linaro Cambridge and Austin locations today
 - Linaro China in Q2/Q3
 - We expect members & member partners to participate
 - All participating facilities can be federated
 - Users will be able to request and purchase instances
- By developers for developers
- Quarterly release cadence

Getting Involved - Yes, we need you!

- ▣ Buy a board and contribute on the 96Boards.org forums
 - ▣ 96Boards Steering Committee member Group, maintaining 96Boards Specifications as well as their evolution
 - ◆ For SoC vendors and Board developers
 - ▣ Manufacturer and Partner programs for Board, mezzanine board and module developers, software companies and universities

Resources

- ▣ www.linaro.org
- ▣ <http://www.linaro.org/leg/servercluster/>
- ▣ <https://wiki.linaro.org/FrontPage>
- ▣ <http://www.96boards.org/>
- ▣ <https://github.com/96boards>
- ▣ <https://github.com/96boards/96BoardsGPIO>
- ▣ <https://github.com/96boards/96boards-build-tools>
- ▣ <https://github.com/jackmitch/libsoc>
- ▣ <https://github.com/intel-iot-devkit/mraa>
- ▣ <https://github.com/intel-iot-devkit/upm>
- ▣ Irc: freenode.net #linaro #96boards

Other Linaro Presentations here at ELC

Speaker	Presentation	Time/Day
Bernhard "Bero" Rosenkränzer	Reducing the memory footprint of the Android AOSP	3:00 PM 4 April - Harbor Ballroom I
Koen Kooi	Designing a Distro from Scratch Using OpenEmbedded	11:50 AM 5 April - Harbor Ballroom G
Arnd Bergmann	Static Code Checking in the Linux Kernel	9:00 AM 6 April - Harbor Ballroom A
Grant Likely	Hardware Design for Linux Engineers	2:35 PM 6 April - Harbor Ballroom G

Questions?